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Development of three-dimensional canine hepatic tumor model based on computed tomographic angiography for simulation of transarterial embolization

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Introduction: Transarterial embolization (TAE) is one of the treatment options for liver masses that are not suitable for surgery and they have been applied in veterinary medicine for about 20years, but surgical resection is considered as the first treatment option, and only a few case reports and articles about TAE in dogs have been published. Although understanding of vascular anatomy for the procedure is important, previous studies lack of the information about hepatic artery anatomy in small and toy-breed dogs. Due to the introduction of 3D print in veterinary medicine, it is now possible to make 3D models for preoperative planning. The purpose of this study is to understand the hepatic arterial vascular structure of various sizes and breeds of dogs, and to develop 3D-printed canine artery models with and without hepatic tumors to simulate TAE procedure.

Methods: CT images of a total of 84 dogs with normal hepatic arteries were analyzed, and the mean value and standard deviation of body weight, celiac artery size, and hepatic artery size were 6.47±4.44kg, 3.28±0.77mm, and 2.14±0.43mm, respectively.

Results: It was established that type 2-2-1, which has two separate hepatic branches—the right medial and left branch and the right lateral branch that runs to the right lateral lobe and caudate process—is the most prevalent of the hepatic artery branch types, as it was in the previous study. The review of 65 CT images of dogs with hepatic tumors showed that 44.6% (29/65) had multifocal lesions in multiple lobes, for which TAE can be recommended.

Discussion: Based on the result, a 3D model of the normal canine hepatic artery and the hepatic tumor was made using one representative case from each group, and despite the models having some limitations in reflecting the exact tactile and velocity of blood vessels, TAE procedure was successfully simulated using both models.

KEYWORDS

hepatocellular carcinoma, transarterial embolization, 3D-printed canine hepatic artery model, transarterial chemoembolization, intervention